light coming from the object, since the same degree of illumination which, under certain conditions, will render the body visible, will under other circumstances, fail to produce any sensible impression. Thus, for example, the lumière cendrée, or earth-shine on the moon, which is perceptible by the naked eye after sunset, cannot be detected with the aid of a telescope while the sun is above the horizon. This difference is due to the dispersive power of the atmosphere. When the sun's rays fall upon any one of the minute particles of the air, they are reflected in all directions, and the particle, as has been before remarked, becomes virtually a luminous point. The result of these reflections at all the particles of the air is the appearance of the bright blue sky; and when we turn a telescope towards any portion of the sky the field of view is illuminated by what we may call the light of the sky, that is, by the light of the sun which has been reflected from the particles of the atmosphere. If, now, we direct the telescope, during daylight, to a heavenly body, the field of view will be illuminated *generally* by the light of the sky; and the part of the field where the image of the body is formed will receive the proper light of the body in addition to the light of the sky; consequently, the visibility of the body will depend upon the excess of light upon this spot, above the general illumination of the field; and it is obvious that this excess will bear a ratio to the whole illumination, which will vary with the intensity of the light of the sky. In order that the image may be visible, it is found by experience that this excess must be equal to at least one-sixtieth of the general illumination; if this is not the case, though the image of the body is really formed upon the field of view, our eyes are incapable of distinguishing it from the surrounding parts of the field. Thus the greater the brightness of the field produced by the atmospheric reflection, the less will be our chance of seeing a luminous body situated beyond the atmosphere. As an illustration of this may be noticed the power of seeing the stars by daylight through a long telescope or tube. When the eye is unprotected, the retina is illuminated by rays reflected from nearly half the atmospheric particles above the horizon; whereas, when we look through a long tube, it is only from particles situated in a comparatively small region that the eye can receive light, and thus the light of the star becomes of greater importance—bears a larger proportion to the whole illumination—and may, if the tube be long enough, become as much as one-sixtieth of the general illumination, and thus render the star visible.

To return, then, to the moon's disc as seen beyond the sun during the eclipse. Is it possible that the lumière cendrée can be the cause of its being thus visible? If so, that light must be equal to at least one-sixtieth of the light of the sky received on the field of the telescope in the neighbourhood. Now, this twice reflected light is very feeble, and the exterior portion of the moon was seen by Arago in 1842, when not more than half the sun's diameter was eclipsed, and when the atmospheric illumination must therefore have been far more than sixty times the lumière cendrée. Consequently this explanation of the phenomenon is inadmissible. In fact, according to Arago's explanation, which seems almost certainly the true one, the moon's disc is visible under these circumstances, not because the illumination of her image is greater than that of the surrounding field, but because it is less so. It is seen just as the portion of the moon which is between us and the sun, as a dark object on a bright ground. This bright ground is an object of considerable interest as proving almost conclusively the existence of a non-luminous atmosphere of the sun surrounding the luminous envelope, and capable of reflecting the light proceeding from the latter. The light reflected by this outer atmosphere is so feeble that under ordinary circumstances we cannot perceive it, because it bears so small a proportion to the diffused light of the sky: and even during the progress of an eclipse, although the diffused light becomes more and more feeble as the moon's shadow envelopes more and more of the atmosphere, yet so long as *any* of the rays of the sun are not intercepted, the light of the sky is strong enough to prevent our seeing that reflected by the external envelope of the sun. When, however, the eclipse becomes total, all the direct light of the sun is cut off from the portion of the atmosphere through which we are looking, and the only illumination of the sky in the neighbourhood of the sun is that produced by rays which have been already reflected at distant parts of the earth's atmosphere. The illumination thus produced is very feeble, and the light reflected by the sun's atmosphere then becomes visible as a broad ring of light or corona, surrounding the dark body of the moon, and diminishing in brightness as it recedes from the sun's disc; but the moment the sun re-appears, this corona vanishes again, so that there is no chance of seeing it directly during any partial or annular eclipse however large. When, however, about half the sun's disc is eclipsed, the illumination of the field of a good telescope, arising from the reflected light of the atmosphere, is considerably reduced, and the excess of the illumination of the image of the corona above that of the dark body of the moon becomes perceptible, and renders the outline of the latter body visible. The truth of this explanation is strongly confirmed by the fact that the exterior portion of the moon is most distinctly seen *near* the sun's limb; which is in accordance with the theory, inasmuch as the corona, which forms the bright ground, is more strongly illuminated in that neighbourhood than at a greater distance.

We are now in a position to explain why this observation would very probably fail, if the object glass of the telescope were imperfectly polished, or had any particles of dust or moisture adhering to it. If the object glass were perfectly transparent, every ray falling upon it (provided its path was not inclined at too large an angle to the axis of the lens) would be entirely refracted in its own proper direction. The illumination, therefore, of the field of view, so far as it was due to the light reflected by the atmosphere, would proceed from a comparatively small patch of the sky surrounding the point to which the axis of the telescope was directed: rays proceeding from other parts would, after refraction, be so much inclined to the axis as to strike the blackened sides of the tube of the telescope, and so be absorbed and lost; so that such rays would contribute nothing to the illumination of the field. Let us suppose that with such a glass the dark exterior portion of the moon's disc can just be distinguished; let us call the atmospheric brightness 60; this will be the illumination of that part of the field where the moon's image is,* the part immediately surrounding this receives also the light of the corona, and since it is *perceptibly* brighter than the moon's image, the number expressing its illumination must be at least 61. Now if we suppose the object glass of the telescope to be imperfectly polished, or not perfectly clean, the rays coming from remote parts of the sky will throw an additional light upon the field of view; for whenever one of such rays falls upon an opaque spot or a speck of dust on the object-glass a portion of it will be scattered in all directions, making the spot virtually a new source of

* Strictly speaking, the moon's image would be illuminated by the lumière cendrée, as well as by the light of the sky; but the former is so inconsiderable in amount, that it may be omitted.